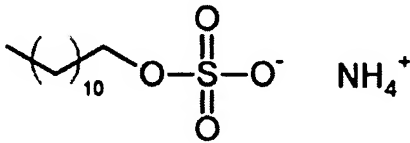


EXHIBIT 6

Ammonium lauryl sulfate

From Wikipedia, the free encyclopedia

Ammonium Lauryl Sulfate (ALS) is the common name for ammonium dodecyl sulfate ($\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{OSO}_3\text{NH}_4$). The dodecyl signifies the presence of a 12-member carbon chain in the molecular backbone which allows the molecule to bond with non-polar portions of molecules while the highly polar sulfate head allows the molecule to bond with polar molecules such as water. ALS is classified as an alkyl sulfate and is an anionic surfactant found primarily in shampoos and body-wash as a foaming agent.^[1] Lauryl sulfates are very high-foam surfactants that disrupt the surface tension of water by forming micelles around the polar water molecules.

Ammonium lauryl sulfate	
	
Systematic name	Ammonium dodecyl sulfate
Chemical formula	$\text{C}_{12}\text{H}_{29}\text{NO}_4\text{S}$
Molecular mass	283.43 g/mol
Density	x.xxx g/cm ³
Melting point	xx.x °C
Boiling point	xx.x °C
CAS number	[2235-54-3]
Disclaimer and references	

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Action in Solution

Ammonium lauryl sulfate, like any other surfactant, makes a good base for cleansers because of the way it disrupts the hydrogen bonding in water. Hydrogen bonding is the primary contributor to the high surface tension of water. In solution, the lauryl sulfate anions and the ammonium cations separate. The former align themselves into what is known as a micelle, in which the ions form a sphere, with the polar heads (the sulfate) on the surface of the sphere and the polar hydrophobic tails pointing inwards towards the center. The water molecules around the micelle arrange themselves around the polar heads, but this disrupts their hydrogen bonding with the water surrounding them. The overall effect of having these micelles in an aqueous (water) environment is that the water becomes more able to penetrate things like cloth fibers or hair, and also becomes more readily available to solvate anything coming off the aforementioned substance.

Health Concerns

In high concentrations this molecule may cause severe irritation to eyes and skin. Inhalation may cause irritation to the respiratory system. Ingestion may cause irritation, nausea or diarrhea.^[2]

In a 1983 report by the Cosmetic Ingredient Review, shampoos containing up to 31% ALS registered 6 health complaints out of 6.8 million units sold. These complaints included two of scalp itch, two allergic reactions, one hair damage and one complaint of eye irritation.^{[3][4]}

The CIR report concluded that both Sodium Lauryl Sulfate and Ammonium Lauryl Sulfate “appear to be safe in formulations designed for discontinuous, brief use followed by thorough rinsing from the surface of the skin. In products intended for prolonged use, concentrations should not exceed 1%.”

The Human and Environmental Risk Assessment (HERA) project performed a thorough investigation of all alkyl sulfates, as such the results they found apply directly to ALS. Most alkyl sulfates exhibit low acute oral toxicity, no toxicity through exposure to the skin, concentration dependent skin irritation, and concentration dependent eye-irritation. They do not sensitize the skin and did not appear to be carcinogenic in a two year study on rats. The report found that longer carbon chains (16-18) were less irritating to the skin than chains of 12-15 carbons in length. In addition, concentrations below 1% were essentially non-irritating while concentrations greater than 10% produced moderate to strong irritation of the skin.^[5]

Environmental Concerns

The HERA project also conducted an environmental review of alkyl sulfates that found all alkyl sulfates are readily biodegradable and standard

wastewater treatment operations removed 96-99.96% of short-chain (12-14 carbons) alkyl sulfates. Even in anaerobic conditions at least 80% of the original volume is biodegraded after 15 days with 90% degradation after 4 weeks.^[6]

Suppliers

See the referenced website for a list of suppliers.^[7]

Occupational Exposure

The CDC has reported on occupations which were routinely exposed to ALS between 1981 and 1983 during this time the occupation with the highest number of workers exposed was registered nurses followed closely by funeral directors.^[8]

Names carrying the same CAS Number

- Sulfuric Acid, monododecyl ester, ammonium salt
- Ammonium dodecyl sulfate
- Ammonium dodecyl sulphate
- Various trade names (see reference for up-to-date list^[9])

References

- ¹ ^ Household Products Database – Ammonium Lauryl Sulfate (<http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=5&query=Ammonium+Lauryl+Sulfate>) . Retrieved on January 25th, 2007.
- ² ^ MSDS for Ammonium Lauryl Sulfate (<http://www.chemistrystore.com/ChemicalMSDS/Ammonium%20Lauryl%20Sulfate.pdf>) . Retrieved on January 25th, 2007.
- ³ ^ Chemical Information Sheet – Ammonium Lauryl Sulfate (http://www.nicnas.gov.au/Publications/Information_Sheets/Existing_Chemical_Information_Sheets/ECIS_ALS_PDF.pdf) . Retrieved on January 25th, 2007.
- ⁴ ^ CIR publication "Final Report on the Safety Assessment of Sodium Lauryl Sulfate and Ammonium Lauryl Sulfate" JACT 1983 Vol. 2 (No. 7) pages 127-181
- ⁵ ^ Human and Environmental Risk Assessment – Health Risks of Alkyl Sulfates (<http://www.heraproject.com/files/3-HH-04-%20HERA%20AS%20HH%20web%20wd.pdf>) . Retrieved on January 25th, 2007.
- ⁶ ^ Human and Environmental Risk Assessment for Alkyl Sulphates (<http://www.heraproject.com/files/3-E-04-HERA%20AS%20Env%20web%20wd.pdf>) . Retrieved on January 25th, 2007.
- ⁷ ^ Ammonium Lauryl Sulfate (<http://www.kellysearch.com/us-product-111309.html>) . Retrieved on January 25th, 2007.
- ⁸ ^ National Exposure Survey (1981-1983) (<http://www.cdc.gov/noes/noes4/m2632sco.html>) . Retrieved on January 25th, 2007.
- ⁹ ^ Chemical Database – Sulfuric Acid, monododecyl ester, ammonium salt (<http://environmentalchemistry.com/yogi/chemicals/cn/Sulfuric%20acid,%20monododecyl%20ester,%20ammonium%20salt.html>) . Retrieved on January 25th, 2007.

External links

- Links to external chemical sources

Retrieved from "http://en.wikipedia.org/wiki/Ammonium_lauryl_sulfate"

Categories: Household chemicals | Ammonium compounds | Surfactants | Organosulfates

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